

Water 2020: Regulatory framework for wholesale markets and the 2019 price review

Appendix 5: System operation

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Introduction

This appendix sets out our approach to system operation in water and wastewater. In our work on system operation, we are addressing two separate, but related, issues.

- To what extent are the current arrangements for system operation appropriate and likely to promote innovation, efficiency and resilience?
- To what extent might the above assessment change in the context of our proposed future regulatory approach – in particular, in relation to English bilateral markets as envisaged by the Water Act 2014? What, if any, changes to system operation arrangements might be appropriate to help support our proposed reforms?

This appendix covers:

- system operation in the context of the wider sector;
- what system operation can include;
- water companies as system operators;
- current arrangements for system operation by water companies;
- system operation with third party providers;
- system operation options – appraisal against Water 2020 objectives; and
- how our broader proposals promote improvements in system operation over the longer term.

System operation in the context of the wider sector

The outcomes that customers and society need and want depend on a complex set of interactions across different social, economic and environmental systems. The ability of these systems to produce these outcomes, and their efficiency in doing so, is a function of how well the interfaces between different elements within them work – that is, how well ‘co-ordination’ across the system works.

There are different dimensions of system co-ordination.

- **Scale.** This could be local (catchment), regional, national, or wider (for example, the EU).
- **Time.** Short term (for example, minute-to-minute, real time system balancing), medium term (for example, looking at which sources of supply to be used over weeks and months) or long term (which could include water resource management planning).
- **Depth.** This could be ‘thin’ (for example, providing information to facilitate decision making), ‘thicker’ (for example, specifying the outcome to be delivered and considering different options) or ‘thick’ (for example, specifying outcomes, assessing options and procuring them – the system operator as a ‘single buyer’).
- **Outcomes.** System co-ordination can help achieve a wide range of outcomes, including environmental outcomes (managing river flows and chemicals in the environment), costs (minimising power and treatment chemical costs) and customer outcomes (reducing sewer flooding and increasing water quality).

There are many different ways to address co-ordination:

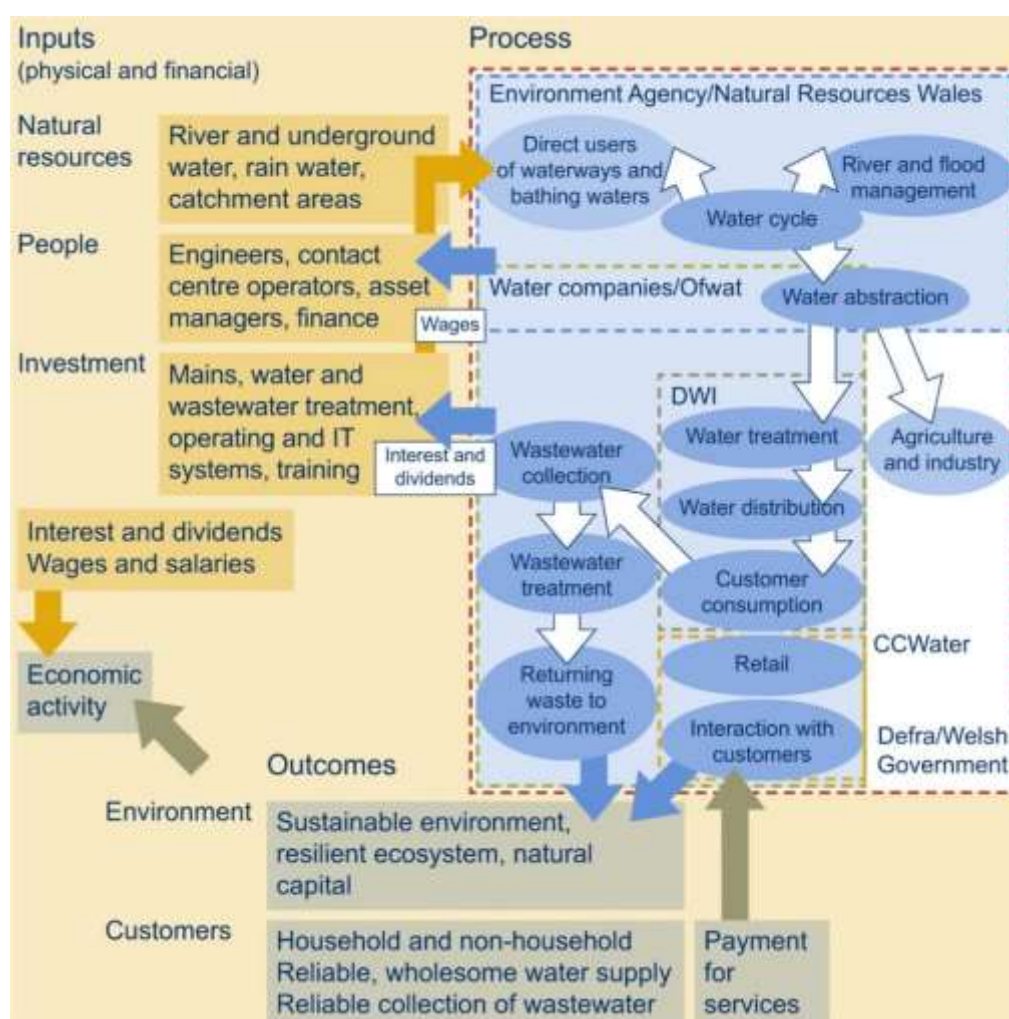
- bilateral contracts in markets;
- integrated ownership structures; or
- dedicated institutions tasked with regulation and planning.

There are several organisations that already play an important role in coordinating the water system.

- The Environment Agency in England and Natural Resources Wales in Wales play a role in co-ordinating management of the natural water environment.
- The Drinking Water Inspectorate (DWI) is responsible for ensuring co-ordination of drinking water quality from source to tap.
- Ofwat creates the economic framework within which the water companies operate.

The diagram below illustrates how the water companies that we regulate, and the water and wastewater systems that they operate (in the green hashed box) form one piece of a wider system co-ordination puzzle.

Figure 1: Water companies in the context of wider system co-ordination



We consider wider system co-ordination further in section 3.6 of the main document.

What can system operation include?

System operation within the context of system co-ordination can be defined in a number of ways. For example, Dieter Helm defines catchments as a ‘system’ with a [Catchment System Operator \(CSO\)](#) planning and co-ordinating delivery across a range of interdependent outcomes – for example, flood, water quality, water resources and natural capital. Under his proposal, the CSO would not undertake any delivery, rather it would drive innovation and efficiency by creating markets that allow different providers to compete to provide services it commissions. This might see, for example, infrastructure providers offering novel approaches to reducing flood risk or landowners reducing emissions from farming as an alternative to water companies building new sewage treatment capacity.

In part, the CSO proposal can be seen as a structural approach to addressing the challenges and opportunities highlighted by Indepen in a [paper](#) sponsored by Severn Trent Water, Wessex Water and South West Water. Here the authors consider barriers to investment in catchment management and how outcomes could be delivered more cost effectively by adopting a payment for ecosystem services approach – that is, markets to deliver environmental outcomes that benefit people, either as water customers or more broadly.

It is important to note that many water companies already play a role in catchment co-ordination through investment in land management schemes and voluntary partnerships such as the [Catchment Based Approach](#). What both Indepen and Dieter Helm highlight is the potential benefit that extending co-ordination could have for companies, customers and the natural environment.

Our approach to price controls, including outcomes and totex, provide appointees with flexibility to develop arrangements to work with wider stakeholders such as catchment management schemes. We note that some aspects of these proposals include catchment governance, land use planning, regulation and funding that are beyond our role as economic regulator of the water sector. We see our role as ensuring that economic regulation facilitates and supports service providers taking account of wider sector interactions in the interests of customers.

Water companies as system operators

Appointed water companies provide a range of system operation functions that are a sub-set of the functions identified above. These include both short- and long-term activities.

In the **short term**, it can include:

- minimisation of power costs, environmental impact (including carbon emissions), chemical costs and leakage;
- delivering appropriate levels of resilience, including:
 - reducing the risk of sewer flooding and interruptions to supply;
 - managing reservoir levels and security of supply; and
 - scheduling maintenance and responding to emergencies:
- short-term matching of supply and demand¹; and
- managing the logistics of the transportation of sludge from wastewater treatment works (WWTWs) to sewage sludge treatment centres (STCs), obtaining the best value for sludge.

In the **longer term**, it can include:

- managing water quality issues from mixing water from different sources; and
- planning long-term network development within the regulatory framework for the sector.

Some of these activities only relate to water and sewerage companies (WaSCs), while others are relevant to both WaSCs and water only companies (WoCs). The more of these functions that are included within system operation, the ‘thicker’ system operation is said to be. For example, a ‘thin’ definition of system operation might only include one or two of the function set out above, such as the short-term matching of supply and demand and management of resilience. However, the ‘thickest’ definition might include all of the above functions. For the purposes of this appendix, we have included all of the above activities in our definition of system operation.

¹ Some companies match supply and demand every half hour, each day and some over the month.

It is important to note that identifying the functions of 'system operation' does not necessitate the separation or creation of a 'system operator'. It may be the case that these functions can be delivered effectively through water companies, although this may create challenges for co-ordinating the system operation function itself across the different parts of the business.

Current arrangements for system operation by water companies

Each of the appointed companies currently carries out all of the above activities in its supply area, although few have dedicated business units specifically to perform them. These functions are not necessarily carried out at a company level, with operations (at least short-term optimisation) often carried out on a more localised/network scale. For example, Northumbrian Water operates its water systems separately over each of its three network areas:

- North East;
- Essex; and
- Suffolk.

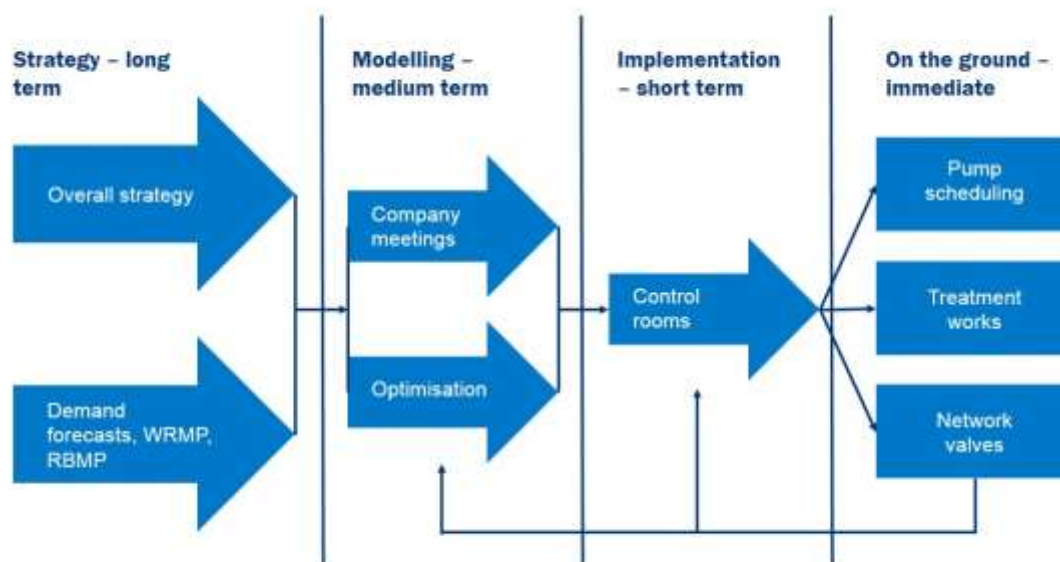
System operation also appears to be carried out separately for sewerage and water in some WaSCs. This is likely to reflect, in particular, that:

- companies have established separate systems, including relevant IT, to support these activities across sewerage and water; and
- the fact that the underlying issues associated with system operation differ somewhat across sewerage and water. For example, the water system operator must consider water availability, while there is no corresponding issue in sewerage.

However, even where systems are wholly separate, the function of one service can have a direct impact on the other. For instance, a burst pipe will increase the volume of water entering the sewerage network.

The following diagram provides a stylised illustration of system operation functions.

Figure 2: Diagrammatic representation of system operation functions



Source: Adapted from Oxera² (2012).

Although the main functions of system operation are similar for all companies, their approaches to undertaking them vary significantly. To some extent, this appears to reflect legacy issues, such as differences in network configuration, size and geography. Some of the notable differences between companies in their approach to system operation include:

- whether they have a formal control room (or rooms where sewerage is managed separately);
- whether they have a computer system to optimise the network – some WoCs (where the networks are smaller and less complex) rely on judgement, rather than formal models;
- the use of different optimisation system models (such as MISER, Aquaterra and WRAP) and the information used in optimising the system (for instance, some models do not hold cost data);

² Oxera (2012) Network Optimisation, Options in setting future price limits in the England and Wales water industry.

- different timespans are used for optimisation (as set out above, in water this can be half-hourly, daily or even monthly); and
- different levels of automated optimisation control (that is links between control rooms and treatment and valve assets).

In the short-term, companies consider numerous factors in optimising their system, many of which are in conflict with each other. Examples include:

- balancing cost and environmental impacts;
- meeting demand against environmental impacts during droughts; and
- weighing cost against security of supply.

In the long-term, company decision-making is subject to a number of processes and plans, including, for example:

- **Water Resources Management Plans (WRMPs):** companies are required to produce WRMPs to demonstrate how they will meet obligations to supply water;
- **River Basin Management Plans (RBMPs):** the Water Framework Directive requires the Environment Agency and Natural Resources Wales to produce RBMPs, with input from the companies and other stakeholders. These set out environmental objectives and the means of delivery;
- **flood risk management plans (FRMP):** managed by the Environment Agency and Natural Resources Wales and Lead Local Flood Authorities (LLFAs). Companies participate in these plans through their roles as Risk Management Authorities; and
- **drainage strategies:** WaSCs are required to produce drainage strategies. These cover how they intend to meet their statutory obligations in relation to drainage (particularly foul, combined and surface water sewers). This includes how they will work with other organisations to manage wider drainage, pollution and surface water flooding in their catchment areas.

The development of these plans is driven in part by the policy objectives and resulting regulation from Defra, Welsh Government, the Environment Agency, Natural Resources Wales and the DWI.

Current regulatory incentives

We have put in place a number of incentives that either directly or indirectly encourage network optimisation. These include:

- **totex:** the PR14 totex approach (and previous top-down opex efficiency targets) incentivises companies to deliver outcomes efficiently – in particular, by providing flexibility for companies to optimise between capital and operating expenditure;
- **outcome delivery incentives (ODIs):** the outcomes approach in PR14 enabled companies to develop and propose outcomes with associated performance commitments and delivery incentives³. This provides flexibility for companies to be innovative in the way that they deliver outcomes and enables companies to take account of wider catchment impacts where this benefits customers, such as through catchment management schemes;
- **service incentive mechanism (SIM):** serviceability indicators and service interruptions directly target the performance of companies' networks, while other measures will also indirectly incentivise improvements on the network, such as customer complaints on network issues; and
- **abstraction incentive mechanisms (AIM):** we introduced the AIM at PR14 to encourage more sustainable abstraction.

Oxera⁴ found evidence from its study that companies:

- have developed their network optimisation modelling capabilities;
- have taken steps to integrate their network grid within company boundaries; and
- may use more automated systems.

In general, companies have focused on optimising networks within their own boundaries, rather than the opportunities across borders. This suggests that further efficiencies may be gained in this area. The AIM incentive may to some extent mitigate this 'inward' focused culture in the water networks, although this effect will be limited as AIM will apply to relatively few sites. However, there are currently no corresponding incentives on the sewerage network.

In our PR14 methodology statement, we said that we might trial a network management incentive during the 2015-20 period and proposed to introduce network management reporting for water networks and sludge gradually over this period.

³ More detail on ODIs is contained in the PR14 final determinations, in particular [policy chapter A2 – outcomes](#)

⁴ Oxera (2012) Network Optimisation, Options in setting future price limits in the England and Wales water industry.

Evidence from the energy sector has also shown that incentives specifically targeted at system operation could lead to efficiency improvements and cost reductions, as a result of greater management focus (see the text box below on system operation in British energy).

System operation in British energy

In both the British electricity and gas industries, Ofgem incentivises the two system operators using incentive schemes. These schemes operate separately from the main RPI-X price controls. The companies are incentivised to meet certain performance standards by the use of a sliding scale of rewards and penalties. For example, National Grid Gas (NGG) produces national gas demand forecasts for up to five days ahead. Accurate demand forecasts help industry participants balance their positions, improving market efficiency and reducing overall system balancing costs. Forecasts for two to five days ahead are subject to an incentive scheme. The lower the average error of the forecasts, the more money NGG can recover from its customers in the following year. For this particular incentive, the highest penalty that can be imposed is £1 million, and the highest bonus, if the forecasts are highly accurate, is £10 million^{5 6}.

Incentivising efficient, economical and robust system operation is one way in which Ofwat can (in accordance with the general statutory duties in section 2 of the Water Industry Act 1991):

- further the consumer and resilience objectives;
- secure that water companies' functions are properly carried out; and
- promote efficiency.

However, there are some key differences between the energy and water sector which may mean that the benefits of explicit short-term system operation incentives have less relevance for water. For example, the water sector remains vertically integrated and so companies will take account of both resource and operational costs in their optimisation decisions.

⁵ National Grid: Demand Forecasting (<http://www2.nationalgrid.com/uk/industry-information/gas-system-operator-incentives/demand-forecasting/>).

⁶ Ofgem (2015) System Operator incentives review 2015 -18: Final Proposals https://www.ofgem.gov.uk/sites/default/files/docs/2015/03/gas_so_incentives_-_final_proposals_2.pdf.

Even with proposed market developments, it is likely that companies will remain responsible for a large proportion of resources for the foreseeable future. This means that, provided the price control framework provides the right incentives, companies will optimise across these activities. Second, optimisation of system operation in the water sector appears to cover a more complex mix of inputs such as environmental quality relative to the energy sector and therefore it may be more complex to develop appropriate incentives.

The development of specific measures of performance may encourage a tendency to focus on optimisation of particular outputs or inputs and distract companies from focusing on the delivery of outcomes.

We now discuss issues that may arise from the involvement of third parties in the wholesale value chain.

System operation with third party providers

Compared to a monopoly situation, with third party service providers, there will be more explicit interaction between separate parties that are not part of the same company. This could result in the system operation function becoming more complex, and therefore potentially more difficult to manage effectively. **This relates to both the short- and long-term dimensions of system operation.** Specifically, the introduction of markets will mean that:

- there may be other water resource providers putting water into the distribution network of pipes;
- the network will need to develop efficiently in response to multiple market participants;
- there will be a greater need **for short-run** and **long-run** co-ordination across and within company borders, including short run balancing of supply and demand (for example, where non-household retailers buy water resources from third parties).

At present, system operation activities are integrated within the rest of the incumbent companies. As a result, the incentives associated with the management of system operation activities may be more aligned to doing what is best for the companies as a whole, rather than for customers or the market from a wider perspective. **This could lead, whether intentionally or not, to discrimination against third party providers.** Examples of discrimination could include situations where an incumbent company:

- with control over which resources/sludge treatment centres are used, chooses its own resource/treatment centre rather than being displaced by that of an entrant;
- directs sludge of better quality for energy production and disposal to land to its own works;
- gives priority to maintenance in parts of its own network which are used by its resources, rather than those of entrants; and
- applies the access pricing framework in such a way as to discriminate against entrants.

If such forms of discrimination were to occur, then clearly there would be the potential for this to adversely affect customers – either through them paying higher prices or receiving lower quality services than they otherwise would. In developing our proposals, therefore, we have had to consider the potential incentives and impacts for these issues in the context of making a greater use of markets.

System operation options – appraisal against Water 2020 objectives

In considering our options in relation to system operation, it is important to distinguish between:

- the **function of system operation itself** (that is, the activities associated with system operation as described here, any financial or other incentives specifically associated with those activities, and the matter of ‘who’ undertakes system operation functions); and
- the **broader issue of how the optimisation of the use of resources can be improved, particularly over the longer run.**

In this appendix, we are specifically addressing the first of the above points. However, it is important to emphasise that our wider set of proposals (particularly those relating to markets, as described elsewhere) are specifically intended to improve long-run optimisation and to encourage a broader, out of company supply area, perspective. We discuss this further at the end of this appendix.

Focusing on the **functional** aspects of system operation (as defined above) we have considered a range of potential options as part of our future regulatory design. There are two aspects to this.

- **Incentives** – that is, either financial or non-financial incentives relating specifically to system operations activities.
- **Functions** – that is, the form of ‘separation’ relating to the functional activities associated with system operation.

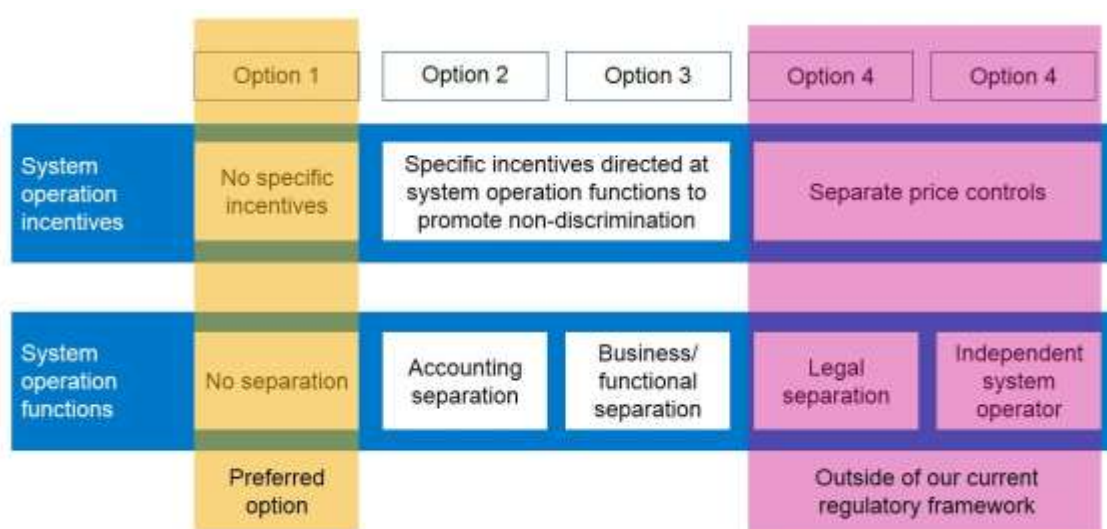
For completeness, the following figure shows the spectrum of options relating to each of the above two dimensions (five options are shown in total). Of these, options 4 and 5 are not implementable, as the forms of separation shown are outside the statutory framework. This leaves us with a choice in the near term between:

- option 1 (which is in effect, **no change**, as it proposes neither any system operation specific incentive, nor any form of separation);
- option 2 (which envisages some form of system operation incentive, supported by accounting separation); and
- option 3 (which would include system operation incentives and functional separation of the system operation function).

Of these, at this time **our preferred option is option 1 – no change – with respect to both incentives and function**. Following the diagram, we briefly set out our evaluation of the options.

However, as we note above, **our wider proposals – as set out elsewhere – are intended to encourage better optimisation, and therefore outcomes, relating to system operation**.

Figure 3: Options considered under system operation



Option 1: no change with regard to incentives and functions (separation)

Under option 1 (no change), we would not propose to implement any specific incentives (either financial or otherwise) targeted at the system operation function in order to mitigate discriminatory concerns. Under this option, the system operation function itself, and its associated activities, would also remain with the incumbent companies (and entrants where such entry occurs) with no proposals for any form of separation regarding these activities. This option would not preclude the development of measures to promote transparency and non-discrimination by the system operator as part of the development of market codes. We will consider such provisions as part of market implementation.

Option 2: develop specific system operation incentives and develop accounting separation for system operation functions

Under option 2, we would develop a set of incentives specifically in relation to system operation activities, designed to address discrimination concerns. Such incentives could include, for example, financial incentives targeted at ‘how’ incumbents optimise resources – and the use, operation and maintenance of those resources. Such incentives could be applied so that they have both a ‘within area’ and ‘broader across area’ dimension. These incentives could constitute the ‘network management’ incentives that were put forward as part of PR14.

Under this option, accounting separation for system operation functions would also be implemented. This would require identification of the relevant costs and assets specifically associated with system operation, but also developing allocation rules and guidance regarding joint/common costs. The effectiveness of any specific **incentives** would tend to be associated with a better understanding of the costs of system operation activities, and so we see these dimensions as being closely linked.

Option 3: develop specific system operation incentives and implement functional/business separation of the system operation functions

Under option 3, system operation would be functionally separated from the rest of the appointee, with implementation by a licence change. This would involve separating the personnel and assets of the system operation function from other functions within the incumbent company, and the creation of a separate business unit to manage this function. Employees and assets would need to be allocated between the system operation business unit and other business units within the company, and new arrangements put in place to manage their interactions.

Under this option, the system operation functions are still integrated within the vertically integrated structure of the incumbent’s business. Therefore, a set of incentives, similar to those set out in option 2 above, would still need to be designed to address discrimination concerns.

Evaluation of the options relating to the system operation function

Table 1 below contains our evaluation of options 1 to 3. We have not evaluated options 4 or 5 as these are outside the current statutory framework.

Table 1: Evaluation of options against criteria

	Option 1 (no change)	Option 2 (incentives and accounting separation)	Option 3 (incentives and functional/business separation)
Meeting our objectives	<p>As this is 'no change', the option does not, in isolation, help meet our objectives directly.</p> <p>This is because we consider other aspects of the wider set of reforms we are proposing to be a more effective means of delivering against our aims.</p> <p>Consequently, we think 'no change' is the proportionate solution in this context.</p>	<p>While the introduction of incentives and accounting separation may weakly support our objectives associated with the development of markets, the extent of their impact is likely to be limited (for the reasons set out below).</p>	<p>Business/functional separation provides a greater degree of separation and independence compared to option 2. However, as the system operation function would still be integrated within the incumbent's business, it may still not provide complete assurance of a level playing field for new entrants, and so will only be marginally better than option 2 for meeting our objectives.</p>
Addressing known problems / issues	<p>As this is 'no change' the proposals here do not, in and of themselves, address any specific problems or issues. However, they should be seen in the wider context of our proposed reforms – where we consider other aspects of our suggested changes to be a more proportionate way of addressing the relevant issues.</p>	<p>It is not clear that accounting separation of system operation functions necessarily addresses issues associated with discrimination or efficiency. This is because these issues relate to the decisions companies make, rather than activities per se. For example, understanding the costs associated with company staff undertaking activities linked to system operation does not, in itself, mean that decisions are any more or less likely to be optimal. For this same reason, incentives targeted at system operation activities may not be effective.</p>	<p>It is not clear, that functional separation of system operation would be sufficient to address discrimination issues or efficiency issues. Functional separation requires a separate management structure (and hence focus) for the system operation function and so should result in a greater degree of independence compared to accounting separation. However, this may only have limited impact, as it will still have, and appear to have, a strong incentive to discriminate against entrants in favour of its own business units.</p>

	Option 1 (no change)	Option 2 (incentives and accounting separation)	Option 3 (incentives and functional/business separation)
Practicality	As this is 'no change' there are no practical or cost implications of the proposals.	There would be some costs associated with the design, development and implementation of accounting separation and incentives – though these may be modest.	This would be possible under the current regulatory framework but it would be more challenging to implement. There would also be significant costs and time involved in its implementation with most costs incurred by companies creating a separate business unit with separate personnel and assets.

Based on the above assessment, we consider that **option 1 (no change) is our preferred option**. It is not clear that either option 2 (incentives and accounting separation) or option 3 (incentives and business/functional separation) would address discrimination or efficiency issues and they would introduce additional costs.

Under both accounting and functional separation, the system operation function will still be owned by the incumbent companies and is therefore unlikely to significantly reduce the incentive of system operation functions to discriminate against entrants. Importantly, as the functions will still be contained within the incumbent business, it will still appear to potential entrants that this potential to discriminate exists.

In addition, specific system operator incentives may not be effective in enhancing efficiency. A number of incentives already exist under the current regulatory framework and it is unclear how specific system operation incentives will be better or more effective at driving efficiency. Functional separation may create better management focus, which could drive efficiency. However, this option would be both difficult and costly to implement.

As noted above, we will consider whether measures to promote a level playing field for the system operator are appropriate as part of the development of market codes. We will also have an opportunity to revisit arrangements as the market develops, if there is evidence of issues with discrimination in the provision of system operator services.

We therefore do not propose to introduce explicit network management incentives in PR19 or within the 2015-20 period. However, we recognise that some companies may feel that reporting or incentives, and/or outcomes specific to network management, may be appropriate for their businesses. Were companies to propose such incentives through an outcome and associated ODIs, we would consider these in our assessment of company business plans.

Conclusion – how our broader proposals promote improvements in system operation over the longer term

While we are not proposing changes to the functional aspects of system operation (as set out above), our wider proposals are intended to help drive improved resource optimisation – which we envisage will (in part) be delivered through improvements to system operation. Of most relevance to this are our proposals to make a greater use of markets in relation to sludge treatment, transport and disposal, and water resources. As these proposals, and our rationale for them, are described in detail elsewhere, we do not repeat them here. However, we do wish to highlight how key aspects of these are likely to lead to improved system operation, especially from a long-term perspective. These include the following.

- For **sludge**, the development of an information platform that will give market participants visibility over capacity, cost and quality data, should encourage players to think more actively about how they optimise decision-making in relation to sludge treatment, transport and disposal over both the near and longer term. In particular, **it should encourage greater optimisation of how existing sludge volumes are processed across company boundaries**. Over the longer term, it should also affect how incumbent companies, and potential third party providers, make investment decisions – especially those relating to capacity.
- For **water resources**, the combination of a market information database, alongside the ability of third parties to ‘bid in’ resources on an ongoing basis, should help to drive a much broader approach to system operation over time and across company boundaries. In addition, **our proposals to implement access pricing (alongside the information transparency that is implicit in our market database proposals) should help protect against the potential for discriminatory behaviour by incumbents in relation to system operation**.

Ofwat (The Water Services Regulation Authority) is a non-ministerial government department. We regulate the water sector in England and Wales. Our vision is to be a trusted and respected regulator, working at the leading edge, challenging ourselves and others to build trust and confidence in water.

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